L8 ANSWER 4 OF 5 CA COPYRIGHT 2000 ACS
AN 124:103885 CA
TI Plasma **etching**
IN Nawata, Makoto; Yakushiji, Mamoru
PA Hitachi Ltd, Japan
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM H01L021-3065

ICS C23F004-00; H01L021-304
CC 76-3 (Electric Phenomena)
FAN.CNT 1

| | PATENT NO. | KIND | DATE | APPLICATION NO. | DATE |
|---|---|---|---|---|---|
| PI | JP 07263408 | A2 | 19951013 | JP 1994-46817 | 19940317 <-- |

AB Plasma **etching** of **Si**, **Polycryst. Si**
, or a **silicide** involves (1) **cleaning** using a F-contg.
gas plasma, (2) **seasoning** by a gas plasma mixt. contg. .gtoreq.2
selected from HCl, BF3, and/or **Cl**, (3) pre-**etching** by
plasma of an **etching** gas, and (4) **etching** using
**Cl**(g) optionally mixed with O(g). SiF light emission spectra may
be monitored for finishing the **seasoning** and beginning the
**etching**.
ST **silicon** plasma **etching** chlorine gas; **silicide**
plasma **etching** chlorine gas
IT Sputtering
(**etching**, plasma **etching** of (**polycryst.**)
**silicon** or **silicide**)
IT **Etching**
(sputter, plasma **etching** of (**polycryst.**)
**silicon** or **silicide**)
IT 2551-62-4, Sulfur hexafluoride 7782-41-4, Fluorine, uses 7783-54-2,
Nitrogen trifluoride 7790-91-2, Chlorine trifluoride 13709-36-9,
Xenon
difluoride
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(**cleaning** gas; plasma **etching** of (**polycryst**
.) **silicon** or **silicide**)
IT 7782-44-7, Oxygen, uses 7782-50-5, Chlorine, uses
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(**etchant**; plasma **etching** of (**polycryst.**)
**silicon** or **silicide**)
IT 11128-24-8P, **Silicon** fluoride (SiF)
RL: ANT (Analyte); PNU (Preparation, unclassified); ANST (Analytical
study); PREP (Preparation)
(light-emission spectrum; in plasma **etching** of (
**polycryst.**) **silicon** or **silicide**)
IT 7440-21-3, **Silicon**, processes 12651-10-4, **Silicide**
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(plasma **etching** of (**polycryst.**) **silicon**
or **silicide**)
IT 7637-07-2, Boron trifluoride, uses 7647-01-0, Hydrogen chloride, uses
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(**seasoning** gas before **etching**; plasma
**etching** of (**polycryst.**) **silicon** or
**silicide**)

DERWENT-ACC-NO: 1995-387417
DERWENT-WEEK: 199550


103

TITLE: Plasma etching method for cleaning semiconductor wafer - comprises etching with plasma gas contg. fluorine, treating with mixed gas plasma using e.g. hydrogen chloride and boron tri:fluoride gas, etc..

PRIORITY-DATA:
1994JP-0046817 March 17, 1994

~~Makoto et al~~ Nawata et al

PATENT-FAMILY:

| PUB-NO | PUB-DATE | LANGUAGE | PAGES | MAIN-IPC |
|---|---|---|---|---|
| JP 07263408 A | October 13, 1995 | N/A | 004 | H01L021/3065 |

INT-CL (IPC): C23F 4/00; H01L 21/304; H01L 21/3065

ABSTRACTED-PUB-NO: JP07263408A
BASIC-ABSTRACT:

Si or polycrystalline-Si or silicide is cleaned by etching using plasma gas contg. F, seasoning treated with mixed gas plasma using HCl gas of BF3 gas or mixed gas of at least 2 selected from HCl, BF3, Cl2 and pre-etching treated by plasma contg. etching gas of Cl or mixed gas of Cl2 and O2, and then etched by Cl gas or mixed gas of Cl2 and O2.

USE - The method is suitable for cleaning of semiconductor wafer.

ADVANTAGE - Variation of etching speed on Si and oxide film is prevented by restraining effect of remaining F after cleaning.

L9 ANSWER 4 OF 5 JAPIO 
AN 1995-263408 JAPIO
TI PLASMA **ETCHING** METHOD
IN NAWATA MAKOTO; YAKUSHIJI MAMORU
PA HITACHI LTD, JP (CO 000510)
PI **JP 07263408** A 19951013 Heisei
AI JP1994-46817 (JP06046817 Heisei) 19940317
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 95, No. 10
IC ICM (6) H01L021-3065
ICS (6) C23F004-00; (6) H01L021-304

AB PURPOSE: To avoid the fluctuation in the residual underneath film for assuring an excellent **wafer-to-wafer** uniformity by a method wherein the **etching** step is to be started after **cleaning** and **seasoning** steps using HCl, BCl3 gas plasma as well as preetching step using an **etching** gas plasma.
CONSTITUTION: A **cleaning** gas (SF6), a **seasoning** gas (BCl3) and an **etching** gas (**Cl2** gas) fed from a feeder 8 by a magnetic field and microwave electric field formed by DC fed from a magnetic field generating DC current 5 to solenoid coils 6, 7 are to be made plasmatic. Next, a preprocessing chamber 4 is **cleaned** up using **cleaning** gas (SF6) plasma while the **seasoning** and preetching steps of the processing chamber are performed using the **seasoning** gas (BCl3 gas plasma) and the **etching** gas plasma (**Cl2**). At this time, a **wafer** 10 mounted on a mounting electrode 9 is **etched** away using the **etching** gas (**Cl2**). Through these procedures, the effect of residual fluorine after the **cleaning** step is averted thereby enabling the fluctuation in the **etching** rate of **Si** and an **oxide** film to be avoided.

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ST **silicon** plasma **etching** chlorine gas; **silicide** plasma **etching** chlorine gas
IT Sputtering
(**etching**, plasma **etching** of (**polycryst.**) **silicon** or **silicide**)
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(sputter, plasma **etching** of (**polycryst.**) **silicon** or **silicide**)
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RL: NUU (Nonbiological use, unclassified); USES (Uses)
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IT 11128-24-8P, **Silicon** fluoride (SiF)
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(light-emission spectrum; in plasma **etching** of (**polycryst.**) **silicon** or **silicide**)
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RL: PEP (Physical, engineering or chemical process); PROC (Process)
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RL: NUU (Nonbiological use, unclassified); USES (Uses)
(**seasoning** gas before **etching**; plasma **etching** of (**polycryst.**) **silicon** or **silicide**)

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平7－263408

(43)公開日　平成7年(1995)10月13日

| (51)Int.Cl.⁶ | 識別記号 | 庁内整理番号 | ＦＩ | 技術表示箇所 |
|---|---|---|---|---|
| Ｈ０１Ｌ　21/3065 | | | | |
| Ｃ２３Ｆ　4/00 | Ｅ | 8417－4K | | |
| Ｈ０１Ｌ　21/304 | ３４１　Ｄ | | | |
| | | | Ｈ０１Ｌ　21/ 302 | Ｎ |
| | | | | Ｆ |

審査請求　未請求　請求項の数３　ＯＬ　（全 4 頁）

(21)出願番号　特願平6－46817

(22)出願日　平成6年(1994)3月17日

(71)出願人　000005108
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(74)代理人　弁理士　小川　勝男

(54)【発明の名称】　プラズマエッチング方法

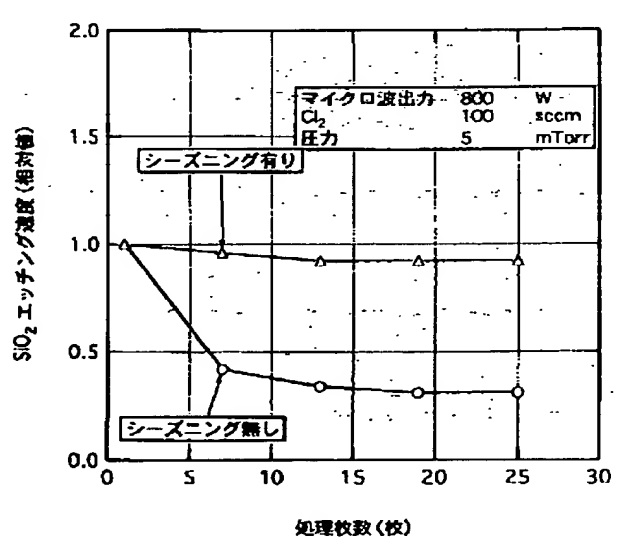
(57)【要約】

【目的】クリーニング後のシリコン及び下地膜である酸化膜（ＳｉＯ₂）のエッチング速度の変化を抑制しウエハ間の均一性を向上させるのに好適なプラズマエッチング方法を提供することにある。

【構成】クリーニング後ＨＣｌあるいはＢＣｌ₃ガスプラズマとＣｌ₂あるいはＣｌ₂とＯ₂の混合ガスプラズマでシーズニング並びにプレエッチングを行い、クリーニング後の処理室（４）内の残留物の影響を減少させる。

【効果】クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。

図　6



【特許請求の範囲】

【請求項1】フッ素を含むガスプラズマによりクリーニングを行い、クリーニング後、塩素ガスの単独ガスあるいは塩素ガスと酸素ガスとの混合ガスをエッチングガスとして用いてシリコン、多結晶シリコン、シリサイドのエッチングを行うエッチング装置において、

前記クリーニング後に塩化水素ガス、三弗化硼素ガスの単独ガスあるいは塩化水素ガス，三弗化硼素ガス，塩素ガスの少なくとも２種類以上の混合ガスのプラズマによるシーズニングとエッチングガスのプラズマによるプレエッチングを行った後エッチングを開始することを特徴とするプラズマエッチング方法。

【請求項2】前記フッ素を含むガスが六フッ化硫黄，三フッ化窒素，二フッ化キセノン，フッ素，三フッ化塩素の単独ガスあるいは混合ガスであることを特徴とする請求項1記載のプラズマエッチング方法。

【請求項3】前記シーズニングにおいてＳｉＦの発光スペクトルをモニターし発光スペクトルの強度の時間変化が一定値以下になった時点でシーズニングを終了しエッチングを開始することを特徴とする請求項1記載のプラズマエッチング方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、フッ素を含むガスプラズマによりクリーニングを行うものに係り、特に、クリーニング後のシリコン及び下地膜である酸化膜（$SiO_2$）のエッチング速度の変化を抑制しウエハ間の均一性を向上させるのに好適なプラズマエッチング方法に関するものである。

【０００２】

【従来の技術】従来、エッチングを含めたプラズマプロセスではウエハの粒子汚染を防止するためにクリーニングを行いクリーニング後の処理室内の残留物をなくすためにポストクリーニングを行っている。$SF_6$，$NF_3$ガスをクリーニングに用いた場合には$N_2$，Ａｒ，$H_2$，$O_2$ガスプラズマがポストクリーニングに用いられている。

【０００３】なお、本技術に関するものとして、例えば、文献：平塚豊著，洗浄設計Ｐ４１－５３，１９９２．Ｓｕｍｍｅｒが挙げられる。

【０００４】

【発明が解決しようとする課題】従来のエッチング方法では、クリーニング後の処理室内の残留物のエッチング特性に及ぼす影響について考慮されておらず、クリーニング後処理枚数とともにシリコン及び下地膜の酸化膜のエッチング速度が減少し、下地酸化膜の残膜が変動するという問題点があった。

【０００５】本発明は、クリーニング後のシリコン及び酸化膜のエッチング速度の減少を抑制し下地酸化膜の残膜の変動を防止し良好なウエハ間の均一性が得られるエッチング方法を提供することにある。

【０００６】

【課題を解決するための手段】上記目的を解決するために、クリーニング後ＨＣｌ，$BCl_3$ガスプラズマによるシーズニングとエッチングガスである$Cl_2$あるいは$Cl_2$と$O_2$の混合ガスプラズマによるプレエッチングを行い、クリーニング後の処理室内の残留物の影響を減少させようとしたものである。

【０００７】

【作用】図１に、$SF_6$ガスプラズマでクリーニングを行った後、$Cl_2$ガスプラズマでシリコンをエッチングした場合におけるＳｉＦ（波長４４１ｎｍ）の発光スペクトルの処理枚数による変化を示す。シリコンとフッ素の反応によって生成するＳｉＦの発光スペクトルの強度は処理枚数とともに減少しほぼ一定となる。このことからフッ素を含むガスによるクリーニング後、処理室内にはフッ素が残留していることが分かった。図２、図３に、$Cl_2$ガスに$SF_6$ガスを添加した場合のＳｉＦの発光スペクトルとシリコン及び酸化膜のエッチング速度の変化を示す。図２、図３に示すように$SF_6$の添加量の増加とともにシリコン及び酸化膜のエッチング速度は増加する。また、$SF_6$の添加量の増加とともにＳｉＦ（波長４４１ｎｍ）の発光スペクトルの強度は増加する。このことから残留フッ素によりシリコン及び酸化膜のエッチング速度は変動し、残留フッ素の減少とともにシリコン及び酸化膜のエッチング速度が低下することを見出した。したがって、クリーニングの後残留フッ素の除去のためＨＣｌ，$BCl_3$ガスプラズマによるシーズニングを行い、ＳｉＦの発光スペクトルの強度の時間変化が一定値以下になった時点でシーズニングを終了し、シーズニング後エッチングガスである$Cl_2$あるいは$Cl_2$と$O_2$の混合ガスプラズマでプレエッチングを行う。シーズニング及びプレエッチングの後、エッチングを開始することによりシリコン及び酸化膜のエッチング速度の変動を抑制できる。また、図４に示すように、Ｃｌに比べＦとの結合エネルギが大きいＨあるいはＢを含むＨＣｌ，$BCl_3$ガスプラズマを用いることにより残留フッ素の除去時間を短縮できることを見出した。

【０００８】

【実施例】本発明の一実施例を図５により説明する。図５は、マイクロ波プラズマエッチング装置の概略図を示したものである。図５において、マグネトロン１から発振したマイクロ波は導波管２を伝播しマイクロ波導入窓３を介して処理室４に導かれる。磁界発生用直流電源５からソレノイドコイル６，７に供給される直流電流によって形成される磁界とマイクロ波電界によってエッチングガス供給装置８から供給されるクリーニングガス（$SF_6$），シーズニングガス（$BCl_3$）及びエッチングガス（$Cl_2$ガス）はプラズマ化される。$SF_6$ガスプラズマにより処理室４のクリーニングが行われる。処理室４

のシーズニング及びプレエッチングが、$BCl_3$ガスプラズマと$Cl_2$ガスプラズマにより行われる。$Cl_2$ガスにより載置電極９に載置されているウエハ１０がエッチングされる。クリーニング、エッチング時の圧力は真空排気装置１１によって制御される。また、ウエハに入射するイオンのエネルギは載置電極９に高周波電源１２から供給される高周波電力によって制御される。図６、図７にシーズニングの有無によるシリコン及び酸化膜のエッチング速度の変化の違いを示す。シーズニング及びプレエッチングは$BCl_3$ガスプラズマと$Cl_2$ガスプラズマにより行い、ＳｉＦの発光スペクトルを１０秒毎にモニタし時間$t_n$と時間$t_{n-1}$に測定したスペクトルの発光強度比が１±０．００２になった時点でシーズニングを停止した。クリーニング後にシーズニングを行うことによりクリーニング時に生成されるフッ素の残留の影響を抑制しエッチング速度の変動を防止できる。

【０００９】本一実施例によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。

【００１０】本一実施例ではマイクロ波プラズマエッチング装置についてその効果を説明したが、他の放電方式例えば反応性イオンエッチング（ＲＩＥ），プラズマモードエッチング（ＰＥ）、マグネトロンＲＩＥ，ヘリコン、ＴＣＰにおいても同様な効果が得られる。

【００１１】

【発明の効果】本発明によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。

【図面の簡単な説明】

【図１】ＳｉＦ発光強度の処理枚数依存性示す説明図である。

【図２】ＳｉＦ発光強度の$SF_6$添加量依存性を示す説明図である。

【図３】Ｓｉ及び$SiO_2$エッチング速度の$SF_6$添加量依存性を示す説明図である。

【図４】ＳｉＦ発光強度の処理時間依存性示す説明図である。

【図５】マイクロ波プラズマエッチング装置の構成図である。

【図６】本発明の一実施例での効果を説明するための$SiO_2$エッチング速度の処理枚数依存性示す説明図である。

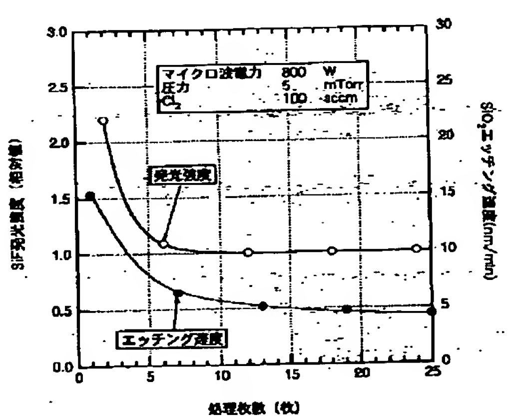
【図７】本発明の一実施例での効果を説明するためのＳｉエッチング速度の処理枚数依存性示す説明図である。

【符号の説明】

２…導波管、３…マイクロ波導入窓、４…処理室、６…ソレノイドコイル。

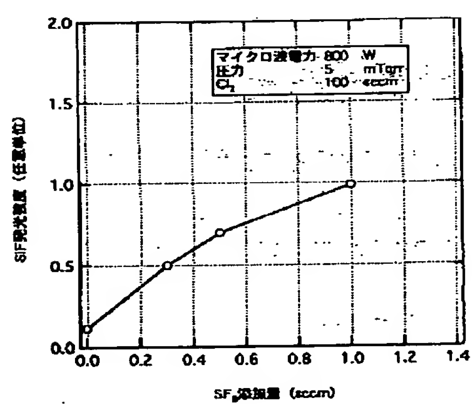
【図１】

図 1



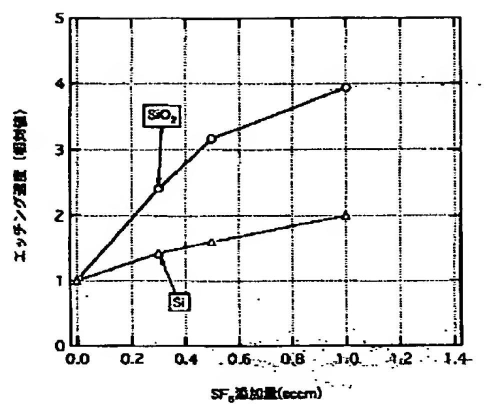

【図２】

図 2



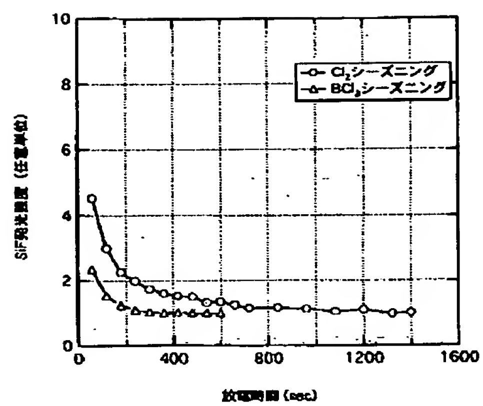
【図3】

図 3



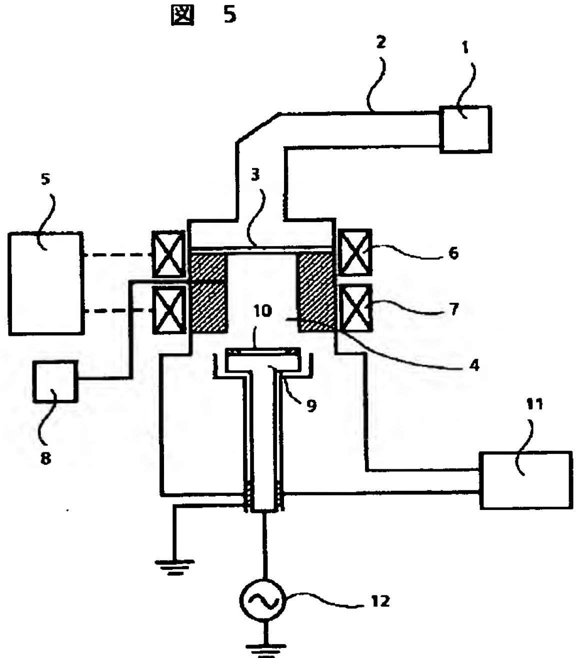

【図4】

図4



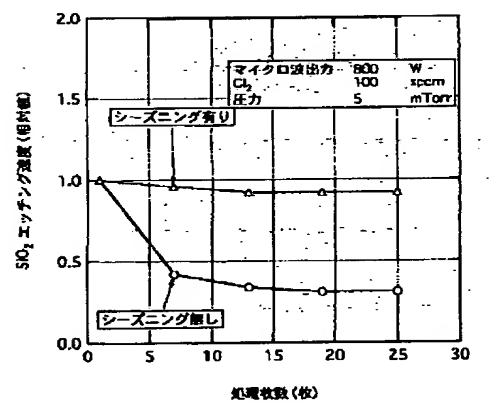

【図5】

図 5



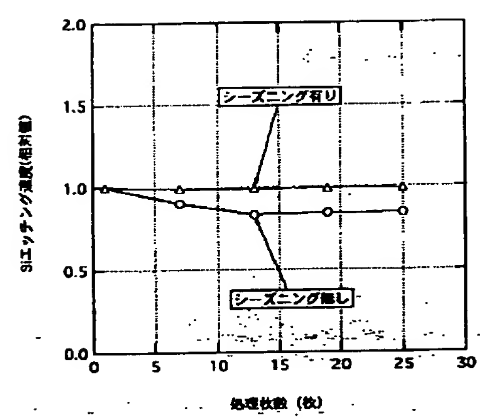

【図6】

図 6




【図7】

図 7



07-263408

* NOTICES *



## CLAIMS

[Claim(s)]
[Claim 1] It cleans by the gas plasma containing a fluorine. After cleaning, In the etching system which performs etching of silicon, polycrystal silicon, and a silicide, using the mixed gas of the independent gas of chlorine gas or chlorine gas, and oxygen gas as etching gas After the aforementioned cleaning, hydrogen chloride gas, Starting etching, after performing seasoning by the plasma of at least two or more kinds of mixed gas of the independent gas of boron-trifluoride gas or hydrogen chloride gas, boron-trifluoride gas, and chlorine gas, and pre-etching by the plasma of etching gas The plasma-etching technique by which it is characterized.
[Claim 2] The plasma-etching technique according to claim 1 characterized by the gas containing the aforementioned fluorine being the independent gas or mixed gas of 2 3 fluoride [ 6 fluoride / sulfur / and nitrogen ] and xenon fluoride, a fluorine, and 3 fluoride-salt **.
[Claim 3] The plasma-etching technique according to claim 1 characterized by ending seasoning and starting etching when it acts as the monitor of the emission spectrum of SiF in the aforementioned seasoning and time change of the intensity of an emission spectrum becomes below a constant value.

[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] It is related with the suitable plasma-etching technique for this invention to relate to what cleans by the gas plasma containing a fluorine, suppress especially change of the etch rate of the oxide film ($SiO_2$) which is the silicon and the substratum layer after cleaning, and raise the homogeneity between wafers.
[0002]
[Description of the Prior Art] Conventionally, in the plasma process including etching, in order to clean in order to prevent grain contamination of a wafer, and to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When $SF_6$ and $NF_3$ gas are used for cleaning, $N_2$, Ar, $H_2$, and $O_2$ gas plasma are used for post cleaning.
[0003] In addition, reference:Hiratsuka ****, washing design P 41-53, and 1992.Summer are mentioned as a thing about this technique.
[0004]
[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.
[0005] this invention is to offer the etching technique by which a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers is acquired.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned purpose, pre-etching by after [ cleaning ] HCl, $Cl_2$ which is seasoning and etching gas by $BCl_3$ gas plasma, or the mixed-gas plasma of $Cl_2$ and $O_2$ tends to be performed, and it is going to decrease the influence of the residue of the processing interior of a room after cleaning.
[0007]
[Function] After cleaning to drawing 1 with $SF_6$ gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with $Cl_2$ gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding $SF_6$ gas in $Cl_2$ gas, silicon, and an oxide film is shown in drawing 2 and the drawing 3 . As shown in drawing 2 and the drawing 3 , the etch rate of silicon and an oxide film increases with the increase in the addition of $SF_6$. Moreover, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of $SF_6$. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine. Therefore, seasoning by HCl and $BCl_3$ gas plasma is performed for elimination of the post-remains fluorine of cleaning, when time change of the intensity of the emission spectrum of SiF becomes below a constant value, seasoning is ended, and pre-etching is performed with $Cl_2$ or the mixed-gas plasma of $Cl_2$ and $O_2$ which is after [ seasoning ] etching gas. Change of the etch rate of silicon and an oxide film can be suppressed by starting etching after seasoning and pre-etching. Moreover, as shown in drawing 4 , it found out that the elimination time of a remains fluorine could be shortened by using HCl and $BCl_3$ gas plasma which contain H or B with large binding energy with F compared with Cl.
[0008]
[Example] Drawing 5 explains one example of this invention. Drawing 5 shows the schematic diagram of a microwave plasma etching system. In drawing 5 , the microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the microwave introduction aperture 3. The cleaning gas ($SF_6$), the seasoning gas ($BCl_3$), and etching gas ($Cl_2$ gas) which are supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8 are plasma-ized. Cleaning of the processing room 4 is performed by $SF_6$ gas plasma. Seasoning and pre-etching of the processing room 4 are performed by $BCl_3$ gas plasma and $Cl_2$ gas plasma. It is etched in the wafer 10 currently laid in the installation electrode 9 by $Cl_2$ gas. The pressure at the time of cleaning and etching is controlled by the evacuation equipment 11. Moreover, the energy of the

ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12. The difference in change of the etch rate of the silicon by the existence of seasoning and an oxide film is shown in drawing 6 and the drawing 7 . BCl3 gas plasma and Cl2 gas plasma performed seasoning and pre-etching, and when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time tn and time tn-1 was set to 1**0.002, they suspended seasoning. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented.
[0009] According to this 1 example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.
[0010] Although this 1 example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (RIE), for example, reactive ion etching, and plasma mode etching (PE) magnetron RIE, Helicon, and TCP.
[0011]
[Effect of the Invention] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

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[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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DETAILED DESCRIPTION

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[0001]
[Field of the Invention] It is related with the suitable plasma-etching technique for this invention to relate to what cleans by the gas plasma containing a fluorine, suppress especially change of the etch rate of the oxide film ($SiO_2$) which is the silicon and the substratum layer after cleaning, and raise the homogeneity between wafers.
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[Means for Solving the Problem] In order to solve the above-mentioned purpose, pre-etching by after [ cleaning ] HCl, $Cl_2$ which is seasoning and etching gas by $BCl_3$ gas plasma, or the mixed-gas plasma of $Cl_2$ and $O_2$ tends to be performed, and it is going to decrease the influence of the residue of the processing interior of a room after cleaning.
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[Function] After cleaning to drawing 1 with $SF_6$ gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with $Cl_2$ gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding $SF_6$ gas in $Cl_2$ gas, silicon, and an oxide film is shown in drawing 2 and the drawing 3 . As shown in drawing 2 and the drawing 3 , the etch rate of silicon and an oxide film increases with the increase in the addition of $SF_6$. Moreover, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of $SF_6$. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine. Therefore, seasoning by HCl and $BCl_3$ gas plasma is performed for elimination of the post-remains fluorine of cleaning, when time change of the intensity of the emission spectrum of SiF becomes below a constant value, seasoning is ended, and pre-etching is performed with $Cl_2$ or the mixed-gas plasma of $Cl_2$ and $O_2$ which is after [ seasoning ] etching gas. Change of the etch rate of silicon and an oxide film can be suppressed by starting etching after seasoning and pre-etching. Moreover, as shown in drawing 4 , it found out that the elimination time of a remains fluorine could be shortened by using HCl and $BCl_3$ gas plasma which contain H or B with large binding energy with F compared with Cl.
[0008]
[Example] Drawing 5 explains one example of this invention. Drawing 5 shows the schematic diagram of a microwave plasma etching system. In drawing 5 , the microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the microwave introduction aperture 3. The cleaning gas ($SF_6$), the seasoning gas ($BCl_3$), and etching gas ($Cl_2$ gas) which are supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8 are plasma-ized. Cleaning of the processing room 4 is performed by $SF_6$ gas plasma. Seasoning and pre-etching of the processing room 4 are performed by $BCl_3$ gas plasma and $Cl_2$ gas plasma. It is etched in the wafer 10 currently laid in the installation electrode 9 by $Cl_2$ gas. The pressure at the time of cleaning and etching is controlled by the evacuation equipment 11. Moreover, the energy of the

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[0009] According to this 1 example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

[0010] Although this 1 example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (RIE), for example, reactive ion etching, and plasma mode etching (PE) magnetron RIE, Helicon, and TCP.

[0011]

[Effect of the Invention] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

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[Translation done.]

Field

[Field of the Invention] It is related with the suitable plasma-etching technique for this invention to relate to what cleans by the gas plasma containing a fluorine, suppress especially change of the etch rate of the oxide film (SiO2) which is the silicon and the substratum layer after cleaning, and raise the homogeneity between wafers.

[Translation done.]

Technique

[Description of the Prior Art] Conventionally, in the plasma process including etching, in order to clean in order to prevent grain contamination of a wafer, and to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When $SF_6$ and $NF_3$ gas are used for cleaning, $N_2$, Ar, $H_2$, and $O_2$ gas plasma are used for post cleaning.
[0003] In addition, reference:Hiratsuka ****, washing design P 41-53, and 1992.Summer are mentioned as a thing about this technique.

[Translation done.]

Effect

[Effect of the Invention] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

[Translation done.]

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.
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[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve the above-mentioned purpose, pre-etching by after [ cleaning ] HCl, Cl2 which is seasoning and etching gas by BCl3 gas plasma, or the mixed-gas plasma of Cl2 and O2 tends to be performed, and it is going to decrease the influence of the residue of the processing interior of a room after cleaning.

[Translation done.]

OPERATION

[Function] After cleaning to drawing 1 with SF6 gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl2 gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF6 gas in Cl2 gas, silicon, and an oxide film is shown in drawing 2 and the drawing 3 . As shown in drawing 2 and the drawing 3 , the etch rate of silicon and an oxide film increases with the increase in the addition of SF6. Moreover, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine. Therefore, seasoning by HCl and BCl3 gas plasma is performed for elimination of the post-remains fluorine of cleaning, when time change of the intensity of the emission spectrum of SiF becomes below a constant value, seasoning is ended, and pre-etching is performed with Cl2 or the mixed-gas plasma of Cl2 and O2 which is after [ seasoning ] etching gas. Change of the etch rate of silicon and an oxide film can be suppressed by starting etching after seasoning and pre-etching. Moreover, as shown in drawing 4 , it found out that the elimination time of a remains fluorine could be shortened by using HCl and BCl3 gas plasma which contain H or B with large binding energy with F compared with Cl.

[Translation done.]

* NOTICES *



## EXAMPLE

[Example] Drawing 5 explains one example of this invention. Drawing 5 shows the schematic diagram of a microwave plasma etching system. In drawing 5 , the microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the microwave introduction aperture 3. The cleaning gas (SF6), the seasoning gas (BCl3), and etching gas (Cl2 gas) which are supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8 are plasma-ized. Cleaning of the processing room 4 is performed by SF6 gas plasma. Seasoning and pre-etching of the processing room 4 are performed by BCl3 gas plasma and Cl2 gas plasma. It is etched in the wafer 10 currently laid in the installation electrode 9 by Cl2 gas. The pressure at the time of cleaning and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12. The difference in change of the etch rate of the silicon by the existence of seasoning and an oxide film is shown in drawing 6 and the drawing 7 . BCl3 gas plasma and Cl2 gas plasma performed seasoning and pre-etching, and when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time tn and time tn-1 was set to 1**0.002, they suspended seasoning. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented.
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[Translation done.]

* NOTICES *



## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is processing number-of-sheets dependency **** explanatory drawing of SiF photogenesis intensity.
[Drawing 2] It is explanatory drawing showing SF6 addition dependency of SiF photogenesis intensity.
[Drawing 3] It is explanatory drawing showing SF6 addition dependency of Si and SiO2 etch rate.
[Drawing 4] It is processing-time dependency **** explanatory drawing of SiF photogenesis intensity.
[Drawing 5] It is the block diagram of a microwave plasma etching system.
[Drawing 6] It is processing number-of-sheets dependency **** explanatory drawing of SiO2 etch rate for explaining the effect in one example of this invention.
[Drawing 7] It is processing number-of-sheets dependency **** explanatory drawing of Si etch rate for explaining the effect in one example of this invention.
[Description of Notations]
2 [ -- A processing room, 6 / -- Solenoid coil. ] -- A waveguide, 3 -- A microwave introduction aperture, 4

[Translation done.]